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Analysis of Metal Temperature Changes during the Axial Water- Air Spray Cooling of Steel Cylindrical Samples

Water-air spray cooling used at integrated processes, including pressure treatment at hot deformation temperatures and heat treatment in line deforming unit. The advantages of this type of cooling is versatility, the possibility of integration into forming processes, low power consumption, compared to laser hardening and lack of harmful environmental emissions. The main objectives of this process are: obtaining a predetermined distribution of mechanical properties along the cross-section of products, the adjustment of the bending deformation due to uneven temperature and product items, preventing the formation of undesirable phases in the structure of metal.

Experiments on the temperature change determination of the metal in the cooling process were conducted at the Leibniz University of Hannover. The temperature distribution in the axial cooling cylindrical sample of 60 mm diameter and 42 mm thick, made of steel 42CrMo4 was investigated. For each experiment six thermocouples (TE1 ... TE6) located radially at intervals of 5 mm were used, thermocouple TE6 was centered in the sample cross-sectional. The heating temperature of the samples was 980 ° C. The distance from the nozzle to the cooling surface in all experiments was 100 mm. Time of exposure to jet -cooled surface was 100 seconds for experiments with water-air cooling.

Due to complicated shapes of temperature drop graphs, which is defined as by the thermal processes taking place in metal, and an inevitable error in experiments, for obtaining quantitative dependence of the samples cooling rate from steel spray parameters is advisable to use a temperature range (800 ... 500 ° C).

For these experiments it was found that repeated increase in water consumption at water-air spray cooling does not lead to an abrupt increase in the rate of cooling. With increasing distance from the cooled surface in the direction of the axis of the sample influence of consumption on the cooling rate changes its character.

Current trends of further investigation of spray cooling parameters effect on thermal fields within the sample are:

- obtaining accurate data on the characteristic points in a coordinate system "time - temperature";
- the definition of the geometric parameters of the samples affecting the rate of cooling;
- clarification of water flow and processing time features on the intensity of the process.